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SMOKE ON THE HORIZON

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Abstract

The U.S. Navy has not operationally deployed obscurant smoke to hide capital ships from being targeted by enemy gunners for many years. One serious drawback to the use of a smoke cloud to cover a ship is that the obscured ship also cannot accurately target the enemy. However with the sensors and guidance systems of today's anti-ship missiles, the older obscurant clouds represented by fog oil type smoke pots will not be effective to mask a ship from many advanced sensors. With the use of new additives and/or new compositions, missiles' sensors can be blocked from achieving lock onto targets. Smoke deployment of the obscurant where the cloud passes over the ship is not advisable due to the effects on ship sensors, gun/missile defensive systems as well as toxic effects of the smoke cloud on ship's personnel.

Smoke on the horizon will place the obscurant cloud at a distance between the ship and the threatening missile. With the advent of the Navy's cooperative engagement capability (CEC), multiple ship and air sensors' data are distributed throughout a battle fleet by a discrete data link. Engagements are moving from a platform centered logic to a network centered logic. A single ship now has sensor eyes both from its own onboard systems in addition to other sensors from other units of the battle group both in the air and on the surface. Threat data can be automatically integrated and implemented to either spoof the threat or destroy it based on a preset computational decision process. Threat speed, angle of arrival (AOA), time of arrival (TOA), and the situational awareness (SA) of the fleet units positions, speed and direction will be known as the threat data from multiple sensors are integrated. Decision processes will automatically take the most appropriate defensive actions based on continuous updates of the theat's position & heading direction. Smoke will be one component of a two component countermeasure system. The second component would be the decoy, either infrared (IR) or radio frequency (RF). The decoy would be launched to the periphery of the smoke cloud, within the field of view of the missile. With the presence of the ship obscured from the threat missile, only the decoy would be viewed. Even missile seekers with decoy discrimination capability would find it impossible to discriminate the decoy from a ship it could not sense.

INTRODUCTION

Naval capital ships have over the last 40 years traditionally operated in an open ocean, blue water scenario. Conflict with opposing naval forces would occur far from shore defensive forces. Today, littoral warfare envisions U.S. Naval forces much closer to shore to support numerous operations such as amphibious landing and rescue. Battle fleet defense can no longer be completely assured by a 500 mile radius protection zone around the Battle Fleet with fleet aircraft. In some cases, fixed or mobile enemy defense systems could engage Naval ships from shore emplacements or from aircraft that can target Naval vessels soon after launch from enemy airfields. Ship defensive systems may be degraded due to the proximity of land masses on ship targeting sensors or other considerations such as political impacts from launching missiles into busy commercial airways. Decoys on the other hand are comparatively benign to the political environment and if effectively used would provide the protection needed in the littoral zone. The issue this paper addresses is the use of obscurants capable of masking ship signatures in both the infrared (IR) and radio frequency (RF) spectrum and how the obscurants should be integrated into a network centered response. These obscurants combined with RF & IR decoys would provide for a much more effective countermeasure (CM) system than employment of either in a singular mode.

SCOPE OF PAPER

This paper will present a radical concept to naval thinkers. Traditional views of smoke were correct when smoke was employed to hide a vessel as it scurried away from a conflict it wanted to leave safely. However this paper will make the case for the use of smoke/obscurant throughout the course of a conflict. No particular delivery system will be identified as the "one" to use, and this paper will not identify the most appropriate smoke/obscurant compositions. A case will be made to support the concept that the U.S. Navy must begin to seriously study the protection of capital ships with decoys and obscurant systems working in a complimentary fashion. What is discussed is how an inherently platform centered action such as individual ship self-protection can be made more effective through a network centered countermeasure system using an integrated decoy with smoke/obscurant response.

ISSUES OF CURRENT COUNTERMEASURE SYSTEM

Advanced missiles with flare rejection and imager guidance use advanced techniques to locate the target and be able to discriminate the target from its decoys. These missiles use advanced decoy rejection techniques that operate to segregate the ship from the decoy by comparing the IR image of the ship and that of the decoy. Also spacial location of the ship and decoy, spectral characteristics of the ship versus that of the decoy's composition, and other notable differences are used to discriminate the ship from the decoy.

The Phase II Ship Infrared Countermeasure Study conducted by the Naval Research Laboratory[1] listed a number of current missiles operating with imager seekers. By the year 2005, most countries who currently operate anti-shipping missiles will have imager guided missiles. This is critical due to the inherent countermeasure resistance shown by missiles that have imager seekers. With missile lethality advancing, seeker designs are harder to defeat by CM. Dual mode seekers (IR/RF), IR imaging, and RF/MMW designs are being introduced by the arms makers. Smoke/obscurant technology developed for tank protection has demonstrated both IR & RF masking. Certain additives will reflect the electromagnetic return from RF seekers much as chaff decoys do and IR signatures can be blocked. The smoke/obscurant must be positioned between the ship and the incoming threat as shown in figure 1. Even the most advanced seeker with the latest decoy rejection circuitry, would not be able to discriminate a decoy from the missile's intended ship target, if the missile could not sense the ship. The only target in the missile's field-of-view would be the decoy. The missile may not "like" the radiated signal of the decoy, but since the decoy is the only hot, radiating item in the missile's view, it naturally would guide to the decoy.

Another issue exists due to the evolving nature of naval warfare. Network centered warfare has or soon will replace the platform centered approach to fighting battles. Network implies that all weapons, and in this case all countermeasures, are orchestrated by a central entity. This would most likely be a computer loaded with the appropriate written code. It would compile missile approach data, tell the countermeasures/weapon systems when to fire, and follow through to make certain the missile was decoyed or destroyed. This system has its genesis in the cooperative engagement capability (CEC) which has begun its deployment on U.S. vessels. However at this time, U.S. ships that have CEC capability currently are not controlling or influencing the deployment of decoy countermeasures.

One other issue must be addressed before the U.S. Navy can utilize smoke/obscurants as envisioned in this paper. Placement of the smoke/obscurant cloud must be accurate and timely. The current ship CM launcher, Mk-36, is fixed to the deck of the ship. Tube angles of 30 or 60 degrees will place decoys in only those places allowed by the ship/launcher geometry. If different decoy function positions would be needed, the ship would be required to maneuver to a changed heading prior to firing. Also, since the launcher is not stabilized in relationship to the ship, significant ship roll will lock out the launch of decoys until the ship regains a near level attitude.

[1] Phase II Ship Infrared Countermeasure Study, Naval Research Laboratory, Dr. Greg Cowart, April 1998

These issues will be addressed in the concept of operation section of this paper. They will be integrated to show how the use of smokes and obscurant along with the CEC and an improved decoy launcher and cartridges will provide the level of protection U.S. warships will require to accomplish their missions in the littoral arena.

CONCEPT OF OPERATION

The smoke/obscurant is like a catalyst in a chemical formulation. By itself, its presence in the countermeasure equation is only part of the answer. Ship self-protection is enhanced however when the smoke is used in conjunction with ship decoys. It is not by itself, that smoke is made effective in countering anti-shipping missiles. Through the denial of target sensing data to an anti-ship missile, the missile must assume the decoy, which is the only source in its field-of-view, is the intended target. This gives the missile little choice other than to guide on the decoy.

Placement of the smoke/obscurant cloud between the incoming missile and the ship is of critical importance. Also, placement of the decoys in conjunction with the smoke cloud must insure the missile, when decoyed, is seduced away from the ship. The decoy must be positioned such that it is in the missiles field-of-view initially. Ship maneuvers and missile redirection due to ship masking must ultimately direct the missile away from the ship. One important concept that will be enhanced by CEC is the positioning of the decoys to "walk" the missile through a battle group using smoke to obscure the ships while using the decoys to not only redirect the missile from its intended target, but also, to redirect it in such a way that the missile cannot inadvertently reacquire a second ship by accident. One ship decoying a missile away from itself only to direct the missile into a second friendly would not be considered a successful CM experience by the second ship. Through the use of the Navy's CEC system, ships could share sensor data on threats from both surface and air sensors. Also, weapons firing can be accomplished by one ship directing another to launch weapons. The CEC is a secure data link tied to a central computer that shares sensor data as well as weapons coordination.

The CM response for a Battle Group could also be coordinated in such a way. Incoming threat data would be transmitted via secure data link from a P-3 to the Battle Group. Missile trajectory track(s) would indicate the anticipated targeted ship(s) and the time-of-arrival (TOA) of the missile on target. A central computer on the targeted ship would compute the appropriate integrated (network) Battle Group response. Smoke/obscurant munitions would be dispatched to an intercept point 1-2 miles from the ship and deployed. Since the missile's trajectory is known, the missile angle of arrival (AOA) can be computed so that smoke and decoys can be placed at the best location. Ship(s) in the Battle Group at the most adventageous positions would be issued launch orders for smoke and decoys from the targeted ship's computer. Since the Battle Group's formation is known by the computer, each ships' speed and direction of travel, and wind direction and speed are known by the central computer, the situational awareness (SA) of the battle plan for this incident is available.

Figure 1 depicts this incident with the luring of the missile away from the targeted ship. In this simulation of an attack, the targeted ship controlled its destiny by coordinating the response to the missile attack. Any ship in the Battle Group could have coordinated the response. The ships which had the best positions to fire smoke/decoys and those with the best positions to fire weapons to destroy the incoming threat would be automatically qued by the computer on the threatened ship. Orders to launch weapons and/or fire decoys/smoke would be sent via CEC to the Battle Group. This whole command and control sequence could be accomplished in seconds during a real operation.

METHODS OF SMOKE DEPLOYMENT

Figure 2 graphically presents some of the concepts to implement smoke/obscurant in the naval environment. Square 2A of Figure 2 illustrates the use of the 5"/54 naval gun as the deployment weapon system. The projectiles would be the delivery vehicle. Advantages of this deployment system is the rapid delivery time due to the velocity of the projectile and rapid fire capability of the gun. Many pounds of the smoke/obscurant can be placed accurately at the deployment location very quickly. Also, if reseed is needed due to adverse wind conditions, the 5"/54 projectile would be responsive in time and speed. The projectile design is a simple and low technology bullet. The costly guidance package is in the stabilized gun mount and aiming hardware. Since no high cost guidance is needed for the bullet, development costs would also be low since a similar illumination projectile already exists. The new 5"/54 cargo round would be apply suited to integrate smoke compositions into this round at a low cost. Disadvantages are that smoke projectiles must be loaded along with high explosive projectiles in the below deck loading drums. The moment a high explosive round is needed, it is possible that only smoke projectiles are available.

The next square, 2B depicts the use of a trainable CM dispenser capable of launching cartridges of smoke composition and decoys to nearby locations (around 1 mile from the ship). Advantages of this system is the quick reaction time for pre-loaded rounds. Pre-loaded cartridges in the launcher can be fired as quickly as the launcher can be slewed. Also, there are numerous foreign navies with this type system so development costs could be minimized since the launcher and decoys could be bought off the shelf. The disadvantages are that the cartridges once expended must be hand reloaded. Deployment ranges are traditionally short, and other decoys must reside alongside the smoke cartridges which lessens the availability of both munitions.

A corridor smoke round is depicted in square 2C. The round's rocket would be fired from a trainable launcher and a fuze would be preset just prior to launch. The smoke payload would be deployed by the fuze at some preselected point in its flight. This system would need to be larger in volume and weight since all the rocket fuel and payload would be carried by the one round.

This system would need to be developed and would be slightly higher in per unit cost compared to the first two CM systems. There may be an effectiveness payback in that this concept might be programmable to dispense in a smarter manner when compared to projectiles and cartridges that merely detonate to spread their payload.

The last square 2D is the technology leader and would be the most versatile in deployment tactics. It obviously will cost the most and will take the longest to develop. It could be fired from a vertical launch tube and be stored below deck. It would be a stealthy addition to any ship. It would leave its launcher and fly by inertial systems to the exact spot it is needed. Both smoke and decoys would be on board and would be released at the proper moment and location to maximize effectiveness.

IN SUMMARY

Littoral warfare could sometimes preclude the use of some ship defensive systems if collateral civilian or political damage might occur from the use of high explosive weapon systems. If an obscurant is used to mask a ship in conjunction with decoys, the decoys become more effective due the inability of the missile to sense the ship. Smoke/obscurants can be placed between the incoming missile and the targeted ship. The smoke is employed at a distance of 1-2 miles from the ship to insure should the missile continue on toward the ship, its defensive weapons will be brought to bear against the missile.

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